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ABSTRACT

Principles of Technology was designed as a high school course in applied science for vocational students in the 11th and 12th grades in Leander, Texas. It consists of a 2-year curriculum covering 14 units in applied physics: (1) force; (2) work; (3) rate; (4) resistance; (5) energy; (6) power; (7) force transformers; (8) momentum; (9) waves and vibrations; (10) energy convertors; (11) transducers; (12) radiation; (13) optical systems; and (14) time constants. The curriculum was designed to increase the employability of vocational students, emphasize principles of technology, increase the appeal of instruction, and meet the requirements for high school graduation in science. The bulk of the document consists of three appendices: (1) principles of technology--essential elements and competencies; (2) list of equipment and supplies for principles of technology by unit; and (3) advisory committee members and minutes of committee meetings. (NLA)

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PRINCIPLES OF TECHNOLOGY

PROJECT #88420057

FINAL REPORT

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LEANDER INDEPENDENT SCHOOL DISTRICT

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FINAL REPORT

PRINCIPLES OF TECHNOLOGY

TEA Project #88420057

prepared for

The Texas Education Agency

LEANDER INDEPENDENT SCHOOL DISTRICT

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TO: TEXAS EDUCATION AGENCY
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Austin, Texas 78701-1494

FROM: Linda Hanson Gray
Project Director
Leander Independent School District
P. O. Box 218
Leander, Texas 78641

SUBJECT: FINAL REPORT ON A MODEL PRINCIPLES OF TECHNOLOGY GRANT
PROJECT # 88420057

According to the objectives stated in the RFA, A Model Principles of Technology Program, the following objectives have been met according to the guidelines. This grant was approved for the continuation of the Principles of Technology I course and the beginning of Principles of Technology II course in Leander High School in Leander Independent School District for the school years, 1986-87, and 1987-88.

DESCRIPTION OF PRINCIPLES OF TECHNOLOGY I AND II

Principles of Technology has been designed as a high-school course in applied science for vocational-technical students in the 11th and 12th grades. It has consisted of a two-year curriculum covering fourteen units in applied physics. These units are:

1. Force
2. Work
3. Rate
4. Resistance
5. Energy
6. Power
7. Force Transformers
8. Momentum
9. Waves and Vibrations
10. Energy Convertors
11. Transducers
12. Radiation
13. Optical Systems
14. Time Constants

The full curriculum also was compiled to:

* increase the employability of vocational students.
* emphasize principles rather than specifics of technology and provide

an understanding of the mathematics associated with these principles.

* increase the appeal of instruction by using an interest-holding instructional system incorporating video presentations, demonstrations, hands-on laboratory exercises, special exercises for students requiring additional help in mathematics, recommendations for "teaching paths" for the teacher and "learning paths" for the students, and a teacher's guide that explained how to orchestrate the learning package.
* maintain the academic rigor needed to meet some of the increased requirements for high school graduation in science.

DESCRIPTION OF ACTIVITIES, MAJOR RESOURCES, AND MATERIALS TO BE USED

Seven units are normally taught in the first year and seven more units in the second year. Each unit typically required twenty-six 50-minute class periods and showed how a technical concept could be analyzed and applied to equipment and devices in mechanical, fluid, electrical, and thermal energy systems. At Leander High School this course was given during a full 55 minute class period, with each unit consisting of several subunits.

Materials for Principles of Technology included student texts, video-cassettes, demonstrations, math labs, and tests. A teacher's guide for each unit provided suggested presentation strategies, information about how to perform classroom demonstrations and additional information for problem-solving labs. As indicated, the suggested teaching plan would require the equivalent of twenty-six 50-minute class periods and the periods would involve:

* unit overview class and unit summary class, with readings, video presentations, discussions and unit tests.
* eight class discussions that include reading assignments (four based on subunit video segments and four based on hardware demonstrations).
* four "problem-solving" math labs.
* eight hands-on physics labs.
* four review periods (repeating the use of the four subunit video segments).

RECOMMENDED TEACHER QUALIFICATIONS FOR THESE COURSES

Ideally, Principles of Technology I and II should be taught by a certified, vocational teacher with industrial experience and a strong background in physics applications. Practically speaking, though, this type of person is atypical and, in most instances, alternate selections can be made successfully. Some other choices would be: (1) a vocational electronics or electro-mechanics teacher, (2)a certified teacher with one to three courses in college physics, (3) a physics teacher with some industrial or applications background and an interest in the Principles of Technology format, and (4) teams of teachers with a physics teacher doing the classroom teaching and math labs, and a vocational teacher doing the hands-on lab. In other states, the team teaching approach has been found to be particularly successful where the two teachers sit in on each other's classes and work together in the classroom and lab presentations.

ESSENTIAL ELEMENTS AND COMPETENCIES FOR PRINCIPLES OF TECHNOLOGY I AND II AND LIST OF SUPPLIES AND EQUIPMENT

During the first year of the Texas Education grant and the continuation of the grant, the suggested essential elements and competencies for Principles of Technology I were written. This past year Principles of Technology II essential elements were compiled. These can be found in Appendix A. The competencies were written with a guideline of rating skills from "4" to "1" with "4" being categorized as skilled and "1" being categorized as no experience or knowledge of this specific area.

In Appendix B the list of equipment and supplies can be found for Principles of Technology I and II, according to each unit's suggested lists of supplies and equipment. This arrangement will make it easier for an instructor to see his needs per unit and will assist in the unit planning. The costs are based on estimates in July and November, 1986, for both course needs.

ADVISORY COMMITTEE AND ITS MEETINGS

Four Advisory Committee meetings were held each year of the project with its members composed of representatives from Austin area businesses and

industries, Leander I.S.D., Austin Community College, Texas Education Agency, University College and University Coordinating Board, and the Center for Occupational and Research Development. At each of these meetings an update was given on the progress of the classes, reactions of the instructor to the teaching of the classes and then input was received from the committee members. The list of Advisory Committee members and the minutes of each of these meetings can be found in Appendix C.

PRINCIPLES OF TECHNOLOGY I AND II AT LEANDER HIGH SCHOOL

During this past school year at Leander High School, the Principles of Technology I class had fifty-eight (58) students and the Principles of Technology II class had five (5) students. The large increase of students in PT I can be credited to the fact that many students last year really enjoyed the class and benefited from it and the "word" spread. Any student on the proper grade level could enroll in these classes. This has not been limited to just those in the 2 + 2 Articulation Program between Leander I.S.D. and Austin Community College. As this report is being finalized, the Fall, 1988, classes have been scheduled with PT I having seventy-one (71) students and the PT II having (16) students.

Mark Kincaid, Principles of Technology instructor at Leander High School, accumulated the pre-test and post-test results for PT II for this year. Because of the difficulty of the first year's units, Mark began this year with Unit 7 and continued through Unit 11, omitted Unit 12, and then finished the year with Unit 13. After consultation with C.O.R.D., the Center for Occupational and Research Development, they recommended that he complete Unit 10. After completing that unit as sequenced, then the following units can be undertaken according to the interest of the class. The Principles of Technology II class chose to undertake Chapter 13 on Optical Systems.

The test results on Unit 7 were pre-test averages of 42 and post-test averages of 93. In Unit 8, the pre-test average was 46 and the post-test average was 98. The pre-test average was 31 and post-test average was 87 for Unit 9. It should be noted here that the level of difficulty, according to Mr. Kincaid, increased noticeably beginning with Unit 7. Also, all of the students in PT II were in PT I during the school year 1986-86, so they were accustomed to the curriculum format and still found the level

of difficulty increasing in each unit. In Unit 10 the class pre-test average was 51 and the post-test was 87. The pre-test results were 39 and post-test were 89 on Unit 11. In Unit 13 the pre-test results were 46 and the post-test results were 96. Mr. Kincaid followed the curriculum closely because he felt that the course sequence was good and the variation of teaching modes kept the students more interested and on task. The variations in teaching modes were lecture, demonstration, video materials, and a planned process of review before testing.

To evaluate this two year project at Leander High School, one of the best possible sources would be to get a statement from the Mark Kincaid, the Principles of Technology I and II instructor. Many times it has been forgotten that it is the teacher and students who are involved who are the real source of reactions and assessments of courses. They are on the "front line" and are the "front line" of the classroom learning situations and experiences. In the following paragraphs are the comments from Mark Kincaid about his feelings and observations on Principles of Technology I and II:

> I began Principles of Technology at Leander High School in the Fall of 1986. The year started with a great deal of excitement and expectation, as I believe all new programs begin. As the second year of P.T. drew to a close in the Spring of 1988, the excitement still runs high and our expectations have been fulfilled.
>
> The expectation for P.T. was that we could create enthusiasm in students for a sometimes frightening subject. The approach of the P.T. curriculum toward applied physics has proven itself to eliminate the anxiety of students while still challenging them to their limit. The key to the P.T. curriculum is the hands-on approach. Students learn to apply in a real work setting the concepts they learn in the classroom. This application many times is what solidifies the concept for the student. They can see that "It really does work."
>
> Student's grades continually improved in P.T. as more and more relative skills were learned. Technological

applications were continually stressed and reinforced by reports from area employers. This helped students see instant relativity and worth of the concepts being covered in class. This makes teaching a lot more fun, also. Several times other instructors commented that their students who were enrolled in P.T. were using their P.T. skills to excell in such classes as Algebra, Chemistry, Electronics, and Trigonometry.

Principles of Technology is an enjoyable, yet challenging course. It definitely has a place in our high school. With P.T.'s ability to give students a broad base of technological awareness and academic skills we foresee a strong future at Leander High School. Whether we are dealing with college-bound or "at risk" students, Principles of Technology can play a vital role in helping students understanding and apply technology in their homes and in the workplace.

SUMMARY

These two years of Principles of Technology I and II in our district have been very rewarding for the student and instructor. The hands-on, applied physics concept has been both challenging to the student and more meaningful. They could see a relation to the "real world of work" from the videos and classroom instruction. The variety of the teaching methods held their interest and made the mathematics application more meaningful to them. As the State moves into more effective teaching of "at risk" students, courses such as Principles of Technology could be a source of motivation for them and a source of significance in their every day lives. The courses have offered them more skills, more understanding of concepts because of their hands-on experiences. Many students have an apprehension towards a "science" class; but these courses gave the academic science rigor of physics to them and at the same time gave them practical classroom and laboratory experiences. Quite often these courses tended to relieve some of this science anxiety.

For some of the students, these classroom teachings will increase their employability in several vocational, technical areas. This

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For some of the students, these classroom teachings will increase their employability in several vocational, technical areas. This

aspect of the courses will become an important factor for many of these students from any secondary school undertaking these courses in other areas of the state.

With the student benefits of practicality, lessening of "science anxiety," hands-on experiences, increase of employability opportunities, emphasis on the practical understanding of mathematics, maintenance of academic rigor, and vocational applications, a school district could benefit in many ways from these offerings. The courses can be taught in the same facilities as the physics classes, which gives another practical usage of classroom space.

Leander I.S.D. has found that Principles of Technology I and II are valuable courses for our students, regardless of whether or not they are college bound,"at risk," or students needing to fulfill high school credit for graduation. The investment of time and expenditures has proven that the "real winner" is the student and that is what our educational system should be attempting to do for any and all of these students.

RECOMMENDATIONS

In light of the information cited in the Summary above, we recommend that Principles of Technology be approved specifically for state graduation credit. We do so for three reasons:

1. The high student interest that has evolved.
2. The student success rate that as occurred.
3. The general consensus, by administrators, business representatives, and teachers, about the importance of this course for preparing students for physics principles in the working world.

Moreover, Leander I.S.D., also considers Principles of Technology I and II worthy for high school science graduation credit. We believe the science concepts and principles contained in Principles of Technology I and II are academically rigorous and offer an additional means for Texas students to broaden their science experience.

APPENDIX A

PRINCIPLES OF TECHNOLOGY I AND II
ESSENTIAL ELEMENTS AND COMPETENCIES

PRINCIPLES OF TECHNOLOGY I
ESSENTIAL ELEMENTS

Principles of Technology I shall be a laboratory oriented course and shall include the following essential elements:

(1) FORCE. The student shall be able to:

a. Describe, in her/his own words, what force is.
b. Give examples of complex technological devices where force must be controlled, measured, or applied.
c. Describe what force, pressure, voltage and temperature difference have in common.
d. Describe or predict what happens in a system when forces are balanced and when forces are unbalanced.
e. Measure force in mechanical, fluid, electrical and thermal systems.
f. List occupations that require technicians to measure, control, or otherwise deal with force in complex devicies.

(2) WORK. The student shall be able to:

a. Describe what is meant by work in general.
b. Describe work in mechanical, fluid and electrical systems.
c. Describe how work in mechanical, fluid, and electrical systems involves the presence of force and movement.
d. Identify correct System International (SI) and English units for work in mechanical, fluid and electrical systems.
e. Identify the effects of work done in mechanical, fluid, and electrical systems.
f. Measure work in mechanical, fluid and electrical systems.

(3) RATE. The student shall be able to:

a. Describe what is meant by rate in general.

b. Describe rate in mechanical, fluid, electrical, and thermal systems.
c. Identify the appropriate System International (SI) and English units for rates for all four energy systems.
d. Measure rate in mechanical, fluid, electrical and thermal systems.
e. Identify workplace applications where rate is measured and/or

controlled.

(4) RESISTANCE. The student shall be able to:

a. Describe what is meant by resistance in general.
b. Describe resistance in mechanical, fluid, electrical, and thermal energy systems.
c. Explain how resistance in each energy system relates to the unifying principle of a "force" divided by a rate.
d. Identify correct System International (SI) and English units for resistance in each energy system.
e. Identify good and bad effects of resistance in each energy system.
f. Identify workplace applications where technicians measure or control resistance.
g. Measure resistance in mechanical, fluid, electrical and thermal systems.

(5) ENERGY. The student shall be able to:

a. Describe the nature of energy in mechanical, fluid, electrical and thermal systems.
b. Describe what is meant by "potential energy."
c. Describe what is meant by "kinetic energy."
d. Describe the relationship between potential energy, kinetic energy, and heat energy in the conservation of energy law.
e. Describe the relationship between work and energy.
f. Identify the appropriate System International (SI) and English units for energy in each system.
g. Measure energy in each system.
h. Identify workplace applications where technicians measure or control energy.

(6) POWER. The student shall be able to:

a. Describe what is meant by power in general.
b. Describe power in mechanical, fluid, electrical and thermal systems.
c. Explain how thermal power and thermal rate are the same.
d. Explain how power in each energy system relates to the unifying principle of work divided by time.
e. Explain why power also can be described in terms of a "force" times a rate for mechanical, fluid and electrical systems.

f. Identify technical workplace applications where technicians measure or control power.

(7) FORCE TRANSFORMERS. The student shall be able to:

a. Describe force transformers.
b. Describe force transformers in mechanical, fluid and electrical systems.
c. Explain why force transformers form a unifying principle in mechanical, fluid and electrical systems.
d. List examples of force transformers in mechanical, fluid and electrical systems.

PRINCIPLES OF TECHNOLOGY I FINAL REPORT

STUDENT COMPETENCIES

DIRECTIONS: Evaluate the student using the rating scale below. CIRCLE the appropriate number to indicate the degree of competency. The rating for each of the tasks should reflect the job readiness rather than the grade earned in the class.

RATING SCALE:
4 = Skilled---can work independently with no supervision.
3 = Moderately skilled---can perform job completely with limited supervision.
2 = Limited skill---requires instruction and close supervision.
1 = No exposure---no experience or knowledge in this area.

UNIT 1: FORCE

SUBUNIT 1: FORCE IN MECHANICAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Define the concept of force in one or two sentences.

4 3 2 1 b. Identify a common device that is used to measure force.

4 3 2 1 c. Name the units of force used in System International (SI) and the English measuring system.

4 3 2 1 d. Describe the results of balanced forces.

4 3 2 1 e. Describe the results of unbalanced forces.

4 3 2 1 f. Briefly define the following: scalar, vector, weight, mass and torque.

4 3 2 1 g. Determine the resultant, given two or more vectors, using appropriate scale diagrams.

4 3 2 1 h. Describe torque's relationship to clockwise and counterclockwise movement.

4 3 2 1 i. Solve torque problems, given force and level arm information.

4 3 2 1 j. Describe a situation where technicians have to measure and apply forces in a mechanical system.

4 3 2 1 SUBUNIT 2: PRESSURE IN FLUID SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Differentiate between hydraulic and pneumatic systems.

4 3 2 1 b. Find the density of a substance, given its mass and volume.

4 3 2 1 c. Determine the specific gravity of a substance, given its density and the density of water.

4 3 2 1 d. Define buoyant force in one or two sentences.

4 3 2 1 e. Define pressure. Identify it as a vector or scalar quantity.

4 3 2 1 f. Explain where atmospheric pressure comes from. State the sea level standard value for atmospheric pressure in the appropriate system of measure.

4 3 2 1 g. Find pressure, force or area, using the formula, p=F/A, given any two of the quantities in the formula.

4 3 2 1 h. Describe the difference between absolute and gage pressure.

4 3 2 1 i. Explain how pressure in a fluid depends on depth of fluid.

4 3 2 1 j. Solve for one quantity, given the other two, in the following equation: p =p h.

4 3 2 1 k. Describe how fluid pressure is a forcelike quantity.

4 3 2 1 l. Given a fluid system with two connected reservoirs, describe fluid levels in each reservoir that will cause fluid motion between reservoirs, or that will cause no motion.

4 3 2 1 m. Explain how manometers are used to measure pressures.

4 3 2 1 n. Describe how a technician might have to measure and/or control pressure in a fluid system.

SUBUNIT 3: VOLTAGE IN ELECTRICAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Differentiate between AC and DC current.

4 3 2 1 b. Identify the most common source of DC voltage.

4 3 2 1 c. Describe the sequence for connecting a DC circuit in series that will cause the voltages to be added.

4 3 2 1 d. Identify three components of a circuit, giving their symbols, including a source, conductor and load (light bulb).

4 3 2 1 e. Describe how frequency and hertz relate to AC current.

4 3 2 1 f. Briefly describe how voltage can be considered a forcelike quantity.

4 3 2 1 g. Name at least three types of voltmeters.

4 3 2 1 h. Briefly describe a situation that requires a technician to measure voltage.

SUBUNIT 4: TEMPERATURE IN THERMAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Identify the direction of movement of heat energy in a thermal system, when temperature information is known.

4 3 2 1 b. Name and describe the forcelike quantity in a thermal system.

4 3 2 1 c. Define temperature in one or two sentences.

4 3 2 1 d. Describe the relationship between heat energy and molecular motion, including how heat energy moves through a system.

4 3 2 1 e. Given Celsius or Fahrenheit temperatures and the formula for conversion, find the equivalent temperature on the alternate scale.

4 3 2 1 f. Summarize in a few sentences when the degree symbol (°) should follow or precede the "F" or "C" abbreviation.

4 3 2 1 g. Describe how thermocouple thermometer measures temperature.

4 3 2 1 h. Briefly describe a situation that requires a technician to control temperature.

UNIT 2: WORK

SUBUNIT 1: WORK IN MECHANICAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Define work done by a force in a mechanical system.

4 3 2 1 b. Explain the relationship between work done on an object, force applied and the distance an object moves.

4 3 2 1 c. Identify the effects of work done by a force in a mechanical system.

4 3 2 1 d. Solve work problems, given force and distance information in English and SI units.

4 3 2 1 e. Explain how efficiency relates to input work and output work for a mechanical system.

4 3 2 1 f. Define work done by a torque in a mechanical system.

4 3 2 1 g. Define radian measure of angles.

4 3 2 1 h. Explain the relationship between work done on an object, torque applied and the angle (in radians) the object moves through.

4 3 2 1 i. Identify the effects of work done by a torque in a mechanical system.

4 3 2 1 j. Solve work problems, given torque and angle information in English and SI units.

4 3 2 1 k. Identify workplace applications where work in mechanical systems occurs.

SUBUNIT 2: WORK IN FLUID SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Describe how open and closed fluid systems are different.

4 3 2 1 b. Describe what is meant by work done in a fluid system.

4 3 2 1 c. Explain the relationship between work and pressure difference in a fluid system, as given in the equation,
WORK = PRESSURE DIFFERENCE x FLUID VOLUME MOVED.

4 3 2 1 d. Explain the relationship between work and pressure in a fluid system, as given in the equation,
WORK = PRESSURE x CHANGE IN VOLUME.

4 3 2 1 e. Solve work problems (given pressure and volume information) in English and SI units.

4 3 2 1 f. Identify the effects of work done in a fluid.

4 3 2 1 g. Identify workplace applications where work occurs in fluid systems.

SUBUNIT 3: WORK IN ELECTRICAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Describe work in electrical systems in terms of the equation,
WORK = VOLTAGE x ELECTRICAL CHARGE MOVED.

4 3 2 1 b. Identify a basic unit of electrical charge as the coulomb.

4 3 2 1 c. Define a coulomb as the charge equal to 6,250,000,000,000,000,000 electrons (6.25×10).

4 3 2 1 d. Solve electrical work problems, given voltage and charge information.

4 3 2 1 e. Identify the effects of work done in electrical systems.

4 3 2 1 f. Identify workplace applications where work in electrical systems occurs.

4 3 2 1 g. Explain how efficiency relates to input work and output work in an electrical system.

UNIT 3: RATE

SUBUNIT 1: RATE IN MECHANICAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Distinguish between linear motion and rotational motion.

4 3 2 1 b. Use the equation, $v = \ell/t$, to describe a linear rate or speed (v) as the distance (ℓ) an object travels along a line in a unit of time (t).

4 3 2 1 c. Use the equation, $v_{av} = \frac{v_i + v_f}{2}$, to calculate the average speed and average velocity when given two linear speeds.

4 3 2 1 d. Describe linear acceleration (a) as linear speed (v) per unit time (t) by using the equation, $a = \frac{v_f - v_i}{t}$

4 3 2 1 e. Describe an angular rate or speed (w) as angular distance (θ) traveled per unit of time (t) by using the equation, $w = \theta/t$.

4 3 2 1 f. Use the equation, $\alpha = \frac{w_f - w_i}{t}$, to describe an angular acceleration (α) as angular speed (ω) per unit time (t).

4 3 2 1 g. Calculate linear and angular rates by using the correct rate equations.

4 3 2 1 h. Identify workplace applications where technicians measure and/or control rate in mechanical systems.

4 3 2 1 i. Measure rates in mechanical systems.

SUBUNIT 2: RATE IN FLUID SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Describe a volume-flow rate (Q_v) as volume (V) moved per unit time (t), or $Q_v = V/t$.

4 3 2 1 b. Describe a mass-flow rate (Q_m) as mass of fluid (m) moved per unit time (t), or $Q_m = m/t$.

4 3 2 1 c. Explain the meaning of the fluid rate equations. Use them to find an unknown.

4 3 2 1 d. Measure rates in fluid systems.

4 3 2 1 e. Identify workplace applications where technicians measure or control rate in fluid systems.

SUBUNIT 3: RATE IN ELECTRICAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Describe charge flow rate (I) as quantity of charge moved (Q) per unit time (t), or $I = Q/t$.

4 3 2 1 b. Explain the meaning of rate in electrical systems. Use rate equations to find an unknown.

4 3 2 1 c. Distinguish between DC and AC current.

4 3 2 1 d. Distinguish between frequency and period.

4 3 2 1 e. Measure rates in electrical systems.

4 3 2 1 f. Identify workplace applications where technicians measure and/or control rate in electrical systems.

SUBUNIT 4: RATE IN THERMAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Describe heat-flow rate (Q_H) as heat energy (H) moved per unit time (t), or $Q_H = H/t$.

4 3 2 1 b. Define rate units for thermal systems, using both English and SI measure.

4 3 2 1 c. Define heat capacity and specific heat.

4 3 2 1 d. Explain the meaning of the equation for thermal system rate. Use this equation to find an unknown value.

4 3 2 1 e. Explain the difference between sensible and latent heat.

4 3 2 1 f. Measure heat rate in a thermal system.

4 3 2 1 g. Identify workplace applications where technicians measure and control rate in thermal systems.

UNIT 4: RESISTANCE

SUBUNIT 1: RESISTANCE IN MECHANICAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Identify sources of resistance in mechanical systems.

4 3 2 1 b. Distinguish between static and kinetic friction.

4 3 2 1 c. Describe kinetic friction as a resistance between moving surfaces.

4 3 2 1 d. Explain the relationship between frictional force (f), the coefficient of friction (μ) and the force pressing two surfaces together (N).

4 3 2 1 e. Use the equation, $f = \mu N$, to calculate an unknown.

4 3 2 1 f. Describe drag force as resistance to objects moving through fluids.

4 3 2 1 g. Show that a drag force obeys the unifying principle of a "force" divided by a rate.

4 3 2 1 h. Describe ways to reduce or increase friction in mechanical systems.

4 3 2 1 i. Measure frictional forces in real applications.

4 3 2 1 j. Identify workplace applications where technicians measure and control resistance in mechanical systems.

SUBUNIT 2: RESISTANCE IN FLUID SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Describe resistance in fluid systems.

4 3 2 1 b. Distinguish between streamlined and turbulent flow.

4 3 2 1 c. Identify sources of resistance for a fluid moving through a pipe.

4 3 2 1 d. Identify the effects of resistance in a fluid flowing through a pipe.

4 3 2 1 e. Compare resistance in a fluid system to resistance in a mechanical system.

4 3 2 1 f. Show that fluid resistance obeys the unifying principle of a "force" divided by a rate in the equation, $R = \Delta p / Q_v$.

4 3 2 1 g. Use the equation, $R_r = \Delta p / Q_v$, to find an unknown.

4 3 2 1 h. Explain how fluid resistance in a pipe depends on (1) pipe area, (2) pipe length, and (3) type of fluid.

4 3 2 1 i. Describe how to reduce fluid resistance in a system.

4 3 2 1 j. Measure fluid resistance in the lab. Express it in appropriate

units.

4 3 2 1 k. Identify workplace applications where fluid resistance is important.

SUBUNIT 3: RESISTANCE IN ELECTRICAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Describe resistance in electrical systems.

4 3 2 1 b. Show that electrical resistance obeys the unifying principle of a "force" divided by a rate.

4 3 2 1 c. Use a graph to explain the relationship between resistance, voltage and current (Ohm's law).

4 3 2 1 d. Use the equation, $R_E = \Delta V/I$, to solve for an unknown.

4 3 2 1 e. Show how resistance in a wire depends on (1) the length of the wire, (2) cross-sectional area of wire, and (3) the material the wire is made of.

4 3 2 1 f. Define resistivity.

4 3 2 1 g. Explain how wire resistance in electrical systems is similar to pipe resistance in fluid systems.

4 3 2 1 h. Find total resistance of two resistors in parallel and series hookups.

4 3 2 1 i. Distinguish between conductors, semiconductors and insulators.

4 3 2 1 j. Measure resistance in electrical systems.

4 3 2 1 k. Identify workplace applications where technicians measure and control resistance in electrical systems.

SUBUNIT 4: RESISTANCE IN THERMAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Describe resistance in a thermal system.

4 3 2 1 b. Identify the effects of resistance in a thermal system.

4 3 2 1 c. Define thermal conductivity.

4 3 2 1 d. Explain the relationship between resistance, temperature difference and heat flow rate.

4 3 2 1 e. Show that thermal resistance obeys the unifying principle of a "force" divided by a rate.

4 3 2 1 f. Use the equation, $R_T = \Delta T/Q_H$, to find an unknown.

4 3 2 1 g. Use the equation, $R_T = \frac{\ell}{k \cdot A}$, to find an unknown.

4 3 2 1 h. Explain the meaning of the R-factor as a measure of relative thermal resistance of insulation.

4 3 2 1 i. Measure thermal resistance in the lab.

4 3 2 1 j. Identify what can be done to reduce-or increase-thermal resistance.

4 3 2 1 k. Identify workplace applications where technicians measure and control resistance in thermal systems.

UNIT 5: ENERGY

SUBUNIT 1: ENERGY IN MECHANICAL AND FLUID SYSTEMS I

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Distinguish between gravitational potential energy and elastic potential energy.

4 3 2 1 b. Calculate gravitational potential energy. Use the formula, $E_p = \omega h$.

4 3 2 1 c. Calculate elastic potential energy. Use the formula, $E_p = 1/2\ kd^2$.

4 3 2 1 d. Calculate spring constant. Use the formula $k = F/d$.

4 3 2 1 e. Calculate fluid potential energy. Use SI units and English units.

4 3 2 1 f. Measure potential energy (E_p).

4 3 2 1 g. Identify workplace applications where technicians measure and control potential energy.

SUBUNIT 2: ENERGY IN MECHANICAL AND FLUID SYSTEMS II

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Distinguish between linear kinetic energy and rotational kinetic energy.

4 3 2 1 b. Calculate linear kinetic energy, using the formula, $E_K = 1/2\ mv^2$.

4 3 2 1 c. Describe what is meant by the moment of inertia (I) of rotating bodies.

4 3 2 1 d. Calculate rotational kinetic energy using the formula, $E_K = 1/2\ I\omega^2$.

4 3 2 1 e. Describe the relationship between work and mechanical energy.

4 3 2 1 f. Use the law of conservation of energy to describe how one form of energy is changed into another form.

4 3 2 1 g. Measure kinetic energy.

4 3 2 1 h. Identify workplace applications where technicians measure and control kinetic energy.

SUBUNIT 3: ENERGY IN ELECTRICAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Describe the nature of potential energy in an electrical system.

4 3 2 1 b. Describe a capacitor. Explain how a capacitor works.

4 3 2 1 c. Define capacitance.

4 3 2 1 d. Use the equation, $E_p = 1/2\ C(V)^2$, to find the electrical energy stored in a capacitor.

4 3 2 1 e. Describe an inductor and how an inductor works.

4 3 2 1 f. Define inductance.

4 3 2 1 g. Use the equation, $E_p = 1/2\ LI^2$, to calculate energy stored in an inductor.

4 3 2 1 h. Describe the relationship between work and electrical energy.

4 3 2 1 i. Measure electrical energy stored in a capacitor.

4 3 2 1 j. Measure electrical energy stored in an inductor.

4 3 2 1 k. Identify workplace applications where technicians measure and control energy in an electrical system.

SUBUNIT 4: ENERGY IN THERMAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Describe the relationship between thermal energy and work.

4 3 2 1 b. Define the mechanical equivalent of heat.

4 3 2 1 c. Use the equation, $H = mc\Delta T$, to find how much heat energy is transferred between two objects of different temperatures.

4 3 2 1 d. Describe three ways to transfer heat energy.

4 3 2 1 e. Describe how heat energy changes states - from solids to liquids, to gases, and back again.

4 3 2 1 f. Describe the role of heat energy in the law of conservation of energy.

4 3 2 1 g. Measure the transfer of heat energy.

4 3 2 1 h. Identify workplace applications where technicians measure or control energy in thermal systems.

UNIT 6: POWER

SUBUNIT 1: POWER IN MECHANICAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Define power in a linear mechanical system as work divided by time, $P = \frac{W}{t}$, or $P = \left(\frac{F \times D}{t}\right)$.

4 3 2 1 b. Explain why power in a linear mechanical system also can be described as force times a rate: $P = F \times \left(\frac{D}{t}\right)$, or $P = F \times v$.

4 3 2 1 c. Define power in a rotational mechanical system as work divided by time: $P = \frac{W}{t}$, or $P = \frac{(T \times \theta)}{t}$.

4 3 2 1 d. Explain why power in a rotational mechanical system also can be described as a force times a rate: $P = T \times \left(\frac{\theta}{t}\right)$, or $P = T \times w$.

4 3 2 1 e. Identify units of power in mechanical systems.

4 3 2 1 f. Show that power in mechanical systems follows the unifying principle of work divided by time (or "force" times a rate).

4 3 2 1 g. Measure power in mechanical systems.

4 3 2 1 h. Use equations for power in mechanical systems to solve for an unknown.

4 3 2 1 i. Define efficiency as output power/input power.

SUBUNIT 2: POWER IN FLUID SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Define power in a fluid system as work divided by time: $P = \frac{(\Delta p) \times V}{t}$, or $P = \frac{p \times (\Delta V)}{t}$.

4 3 2 1 b. Explain why power in a fluid system also can be described as a pressure times a rate. (Since pressure is a forcelike quantity,

power in a fluid system is also a force times a rate.)

4 3 2 1 c. Show that power in a fluid system obeys the unifying principle of work divided by time, or "force" times a rate.

4 3 2 1 d. Use the equation for power in a fluid system to solve for an unknown.

4 3 2 1 e. Measure power in fluid systems.

4 3 2 1 f. Identify workplace applications where technicians measure or control power in fluid systems.

SUBUNIT 3: POWER IN ELECTRICAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Define power in an electrical system as electrical work divided by time, or $P = \left(\frac{V}{t}\right) \times q$.

4 3 2 1 b. Explain why power in an electrical system also can be described as a voltage times a current. Since voltage is a forcelike quantity, this means that power in an electrical system also is a "force" times a rate.

4 3 2 1 c. Show that power in an electrical system obeys the unifying principle of work divided by time, or "force" times a rate.

4 3 2 1 d. Define the units for electrical power.

4 3 2 1 e. Use the equation for power in an electrical system to solve for an unknown.

4 3 2 1 f. Measure power in an electrical system.

4 3 2 1 g. List workplace applications where technicians measure or control power in fluid systems.

SUBUNIT 4: POWER IN THERMAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Define power in a thermal system as work (energy) divided by time.

4 3 2 1 b. Relate power in a thermal system to thermal rate.

UNIT 7: FORCE TRANSFORMERS

SUBUNIT 1: FORCE TRANSFORMERS IN LINEAR MECHANICAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Explain the relationship between INPUT WORK and OUTPUT WORK for linear force transformers.

4 3 2 1 b. Use the equation, WORK IN = WORK OUT, to find an unknown force or displacement when using a pulley system or lever as the force transformer.

4 3 2 1 c. Explain the difference between ideal mechanical advantage (IMA) and actual mechanical advantage (AMA).

4 3 2 1 d. Find the ideal mechanical advantage and actual mechanical advantage of a force transformer.

4 3 2 1 e. Use the equation for efficiency of a force transformer to find the efficiency of a pulley or lever.

4 3 2 1 f. Explain the difference between the three classes of levers.

4 3 2 1 g. List or identify different kinds of force transformers for linear mechanical systems.

4 3 2 1 h. Identify workplace applications where technicians use force transformers.

4 3 2 1 i. Measure the mechanical advantage of a linear force transformer.

SUBUNIT 2: FORCE TRANSFORMERS IN ROTATIONAL MECHANICAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Explain the relationship between input work and output work for rotational force transformers.

4 3 2 1 b. Find the mechanical advantage of a wheel and axle.

4 3 2 1 c. Find the efficiency of a wheel and axle.

4 3 2 1 d. Find the mechanical advantage of a belt-drive system.

4 3 2 1 e. Find the efficiency of a belt-drive system.

4 3 2 1 f. Find the mechanical advantage of a gear-drive system.

4 3 2 1 g. Find the efficiency of a gear-drive system.

4 3 2 1 h. List or identify various rotational force transformers.

4 3 2 1 i. Measure the mechanical advantage of a rotational force transformer.

4 3 2 1 j. Identify workplace applications where technicians use rotational force transformers.

SUBUNIT 3: FORCE TRANSFORMERS IN FLUID SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Explain the relationship between input work and output work for a hydraulic jack.

4 3 2 1 b. Explain how force is amplified through mechanical advantage in a fluid system.

4 3 2 1 c. Find the mechanical advantage of a hydraulic jack.

4 3 2 1 d. Find the efficiency of a pressure intensifier.

4 3 2 1 e. List or identify various fluid transformers.

4 3 2 1 f. Measure the mechanical advantage of a fluid transformer.

4 3 2 1 g. Identify workplace applications where technicians use fluid transformers.

SUBUNIT 4: FORCE TRANSFORMERS IN ELECTRICAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Describe how a voltage transformer is used to "step up" or "step down" voltage.

4 3 2 1 b. Explain the relationship between input power and output power for a voltage transformer.

4 3 2 1 c. Explain the relationship between voltage in, voltage out, and number of wire windings in a voltage transformer.

4 3 2 1 d. Find the "mechanical" advantage of a voltage transformer.

4 3 2 1 e. Find the efficiency of a voltage transformer.

4 3 2 1 f. Measure the "mechanical" advantage of a voltage transformer.

4 3 2 1 g. Identify workplace applications where technicians use electrical transformers.

PRINCIPLES OF TECHNOLOGY II
ESSENTIAL ELEMENTS

Principles of Technology II shall be a laboratory oriented course and shall include the following essential elements:

(8) MOMENTUM. The student shall be able to:

a. Describe linear momentum (in general terms).
b. Describe angular momentum (in general terms).
c. State law of conversation of momentum as it affects linear or angular motion.
d. Describe the relationship of impulse to change in momentum.
e. List examples of how momentum affects mechanical and fluid systems.

(9) WAVES AND VIBRATIONS. The student shall be able to:

a. Describe wave motion in general.
b. Describe how waves transmit (move) energy.
c. List the characteristics that are used to describe a wave.
d. Distinguish between longitudinal and transverse waves.
e. Identify workplace applications where waves and vibrations are found.

(10) ENERGY CONVERTORS. The student shall be able to:

a. Describe the purpose of an energy convertor.
b. Identify convertors that change mechanical energy to fluid or electrical energy.
c. Identify convertors that change fluid to mechanical energy.
d. Identify convertors that change electrical to mechanical or thermal energy.
e. Identify convertors that change thermal to mechanical, fluid or electrical energy.
f. Describe what is meant by the efficiency of an energy convertor.

(11) TRANSDUCERS. The student shall be able to:

a. Define a transducer as a device that senses mechanical, fluid, electrical or thermal information.
b. Describe the action of a transducer in general terms.
c. Distinguish between an energy convertor and a transducer.

d. Identify transducers that change mechanical signals into electrical signals.
e. Identify transducers that change fluid signals into mechanical or electrical signals.
f. Identify transducers that change electrical signals into mechanical or thermal information.
g. Identify transducers that change thermal signals into mechanical, fluid or electrical information.

(12) RADIATION. The student shall be able to:

a. Describe what is meant by "radiation."
b. Describe what is meant by "electromagnetic" radiation.
c. Describe what is meant by "nuclear" radiation.
d. Identify workplace applications where technicians measure or control radiation.

(13) LIGHT AND OPTICAL SYSTEMS. The student shall be able to:

a. Describe how light can be represented by light rays.
b. Describe how light can be represented by waves.
c. Identify the special characteristics of laser light.
d. List several optical systems that "process" light.
e. Identify workplace applications where technicians measure and control light.

(14) TIME CONSTANTS. The student shall be able to:

a. Distinguish between uniform change and nonuniform change.
b. Define a "time constant."
c. Identify systems where time constants are needed to describe system behavior.
d. Define three time constants (labeled "$T_{1/2}$," "T_{90}," and "t").
e. Give examples of time constants in mechanical, fluid, electrical and thermal energy systems.
f. Identify workplace applications where technicians measure and control time constants.

PRINCIPLES OF TECHNOLOGY II FINAL REPORT

STUDENT COMPETENCIES

DIRECTIONS: Evaluate the student using the rating scale below. CIRCLE the appropriate number to indicate the degree of competency. The rating for each of the tasks should reflect the job readiness rather than the grade earned in the class.

RATING SCALE:
4 = Skilled - can work independently with no supervision.
3 = Moderately skilled - can perform job completely with limited supervision.
2 = Limited skill - requires instruction and close supervison.
1 = No exposure - no experience or knowledge in this area.

UNIT 8: MOMENTUM

SUBUNIT 1: MOMENTUM IN MECHANICAL AND FLUID SYSTEMS I

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Define linear momentum.
4 3 2 1 b. Identify appropriate English and SI units for linear momentum.
4 3 2 1 c. Calculate the linear momentum of an object.
4 3 2 1 d. Define linear impulse.
4 3 2 1 e. Explain how the linear impulse ($F \times \Delta t$) is related to a change in the linear momentum $\Delta(mv)$.
4 3 2 1 f. Apply momentum equations to the movement of objects.
4 3 2 1 g. Apply momentum equations to the movement of fluids.
4 3 2 1 h. Describe the conservation of linear momentum in isolated systems.
4 3 2 1 i. Solve a problem that involves conservation of linear momentum.
4 3 2 1 j. Identify workplace applications where technicians measure or control linear momentum.

SUBUNIT 2: MOMENTUM IN MECHANICAL AND FLUID SYSTEMS II

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Define angular momentum.
4 3 2 1 b. Identify appropriate English and SI units for angular momentum.
4 3 2 1 c. Find the angular momentum of an object.
4 3 2 1 d. Define angular impulse.
4 3 2 1 e. Explain how angular impulse relates to a change in angular momentum.
4 3 2 1 f. Apply momentum equations to the rotation of objects.
4 3 2 1 g. Solve a problem that involves conservation of angular momentum.
4 3 2 1 h. Identify workplace applications where technicians measure or control angular momentum.

UNIT 9: WAVES AND VIBRATIONS

SUBUNIT 1: CHARACTERISTICS OF WAVES

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Describe a harmonic wave (sine wave).
4 3 2 1 b. Define the wavelength of a harmonic wave.
4 3 2 1 c. Define the frequency of a harmonic wave.
4 3 2 1 d. Define the period of a harmonic wave.
4 3 2 1 e. Define the amplitude of a harmonic wave.
4 3 2 1 f. Define the phase of a harmonic wave.
4 3 2 1 g. Define wave speed for a traveling harmonic wave.
4 3 2 1 h. State what's meant by the phase difference between two harmonic waves.
4 3 2 1 i. Distinguish between the characteristics of a wave.
4 3 2 1 j. Solve problems that involve wave characteristics.
4 3 2 1 k. Measure the characteristics of a wave.
4 3 2 1 l. Classify waves as longitudinal or transverse.

SUBUNIT 2: APPLICATIONS OF WAVES AND VIBRATIONS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Describe what's meant by interference of waves.
4 3 2 1 b. Describe what's meant by "superposition of waves."
4 3 2 1 c. Define constructive interference.
4 3 2 1 d. Define destructive interference.
4 3 2 1 e. Identify examples of wave interference.
4 3 2 1 f. Define natural frequency of an object.
4 3 2 1 g. Define resonance.
4 3 2 1 h. Identify examples of wave resonance.
4 3 2 1 i. Identify workplace applications where technicians measure and control waves and vibrations.

UNIT 10: ENERGY CONVERTORS

SUBUNIT 1: MECHANICAL ENERGY CONVERTORS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Describe a mechanical energy convertor.
4 3 2 1 b. Explain how a pump converts mechanical energy to fluid energy.
4 3 2 1 c. Explain how a fan changes mechanical energy to fluid energy.
4 3 2 1 d. Explain how an alternator converts mechanical energy to electrical energy.
4 3 2 1 e. Explain how a friction (inertia) welder changes mechanical energy to thermal energy.
4 3 2 1 f. Find the efficiency of a convertor that has mechanical input energy.
4 3 2 1 g. Identify workplace applications where technicians use and control mechanical energy convertors.

SUBUNIT 2: FLUID ENERGY CONVERTORS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Describe a fluid energy convertor.

4 3 2 1 b. Describe how a windmill converts fluid energy to mechanical energy.

4 3 2 1 c. Explain how a turbine changes fluid energy to mechanical energy.

4 3 2 1 d. Describe a process that converts fluid energy to electrical energy.

4 3 2 1 e. Explain how an air conditioner uses fluids to remove thermal energy.

4 3 2 1 f. Find the efficiency of a convertor that has fluid input energy.

4 3 2 1 g. Identify workplace applications where technicians use and control mechanical energy convertors.

SUBUNIT 3: ELECTRICAL ENERGY CONVERTORS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Describe an electrical energy convertor.

4 3 2 1 b. Explain how an electric motor converts electrical energy to mechanical energy.

4 3 2 1 c. Describe how a solenoid changes electrical energy to mechanical energy.

4 3 2 1 d. Explain how high-resistance conducting wire converts electrical energy to thermal energy.

4 3 2 1 e. Find the efficiency of a convertor that has electrical input energy.

4 3 2 1 f. Identify workplace applications where technicians use and control convertors of electrical energy.

SUBUNIT 4: THERMAL ENERGY CONVERTORS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Describe a thermal energy convertor.

4 3 2 1 b. Explain how a bimetallic strip changes thermal energy to mechanical energy.

4 3 2 1 c. Describe how a combustion engine converts thermal energy to

fluid energy.

4 3 2 1 d. Explain how thermopile changes thermal energy to electrical energy.

4 3 2 1 e. Find the efficiency of a convertor that has thermal input energy.

4 3 2 1 f. Identify workplace applications where technicians use and control convertors of thermal energy.

UNIT 11: TRANSDUCTERS

SUBUNIT 1: TRANSDUCERS IN MECHANICAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Explain what a mechanical transducer does.

4 3 2 1 b. Describe how a strain gage translates a mechanical input signal into an electrical output signal.

4 3 2 1 c. Explain the "piezoelectric effect."

4 3 2 1 d. Explain how an accelerometer translates a mechanical input signal into an electrical output signal.

4 3 2 1 e. Solve problems that involve mechanical transducers.

4 3 2 1 f. Identify workplace applications where technicians use mechanical sensors.

SUBUNIT 2: TRANSDUCERS IN FLUID SYSTEMS

4 3 2 1 a. Explain what a fluid transducer does.

4 3 2 1 b. Describe how a bourdon gage changes a pressure input signal into a mechanical output signal.

4 3 2 1 c. Describe how a barometer changes a pressure input signal into a mechanical output signal.

4 3 2 1 d. Describe how a flowmeter changes a fluid rate into an electrical signal.

4 3 2 1 e. Describe how an anemometer changes a wind speed into an electrical signal.

4 3 2 1 f. Solve problems that involve fluid transducers.

4 3 2 1 g. Identify workplace applications where technicians use fluid sensors.

SUBUNIT 3: TRANSDUCERS IN ELECTRICAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Explain what an electrical transducer does.
4 3 2 1 b. Describe how a "moving-coil" transducer changes an electrical input into a mechanical output signal.
4 3 2 1 c. Explain how a meter reading depends on the interaction between an stationary magnetic field and the magnetic field created when current flows through the moving coil.
4 3 2 1 d. Explain why an ammeter has a low-resistance shunt connected in parallel with the transducer circuit.
4 3 2 1 e. Explain why a "voltmeter" has a high-resistance resistor connected in series with the transducer circuit.
4 3 2 1 f. Describe how to calibrate the scale of a voltmeter.
4 3 2 1 g. Describe how an electrostrictive transducer changes an electrical signal into a mechanical signal.
4 3 2 1 h. Describe what a photoconductive transducer does.
4 3 2 1 i. Describe the two types of transducers used in sonar systems.
4 3 2 1 j. Solve problems that involve electrical transducers.
4 3 2 1 k. Identify workplace applications of electrical transducers.

SUBUNIT 4: TRANSDUCERS IN THERMAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Explain what a thermal transducer does.
4 3 2 1 b. Describe how a bimetallic strip changes a thermal input signal to a mechanical output signal.
4 3 2 1 c. Describe how a thermograph changes a thermal input signal into recorded output information.
4 3 2 1 d. Describe how a thermocouple translates a thermal input signal to an electrical output signal.
4 3 2 1 e. Explain how a thermistor changes a thermal input signal to an electrical output signal.
4 3 2 1 f. Solve problems that involve thermal transducers.
4 3 2 1 g. Identify workplace applications where technicians use thermal

transducers.

UNIT 12: RADIATION

SUBUNIT 1: ELECTROMAGNETIC RADIATION

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Describe what is meant by the "electromagnetic (EM) spectrum."

4 3 2 1 b. Identify EM spectrum divisions. Compare their ranges of wavelength and frequency values.

4 3 2 1 c. Identify four characteristics of EM radiation (wavelength, speed, frequency and energy).

4 3 2 1 d. Describe the speed of EM radiation in terms of wave frequency (f) and wavelength (λ).

4 3 2 1 e. Describe a photon. Tell how its energy depends on its wavelength or frequency.

4 3 2 1 f. Solve problems for speed (v) and energy (E) of EM radiation by using the formulas: $v = \lambda f$; and $E = hf$, or $E = hc/\lambda$.

4 3 2 1 g. Describe the wavelength limits, frequency limits and color content of the visible EM spectrum.

4 3 2 1 h. Compare the characteristics of infrared and microwave radiation to light (visible spectrum).

4 3 2 1 i. Compare the characteristics of ultraviolet and X-ray radiation to light (visible spectrum).

4 3 2 1 j. Identify workplace applications where technicians measure and control EM radiation.

SUBUNIT 2: NUCLEAR RADIATION

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Define "nuclear decay."

4 3 2 1 b. Identify the three main components of nuclear radiation.

4 3 2 1 c. Describe what alpha particles, beta particles and gamma rays are by giving their approximate mass and electrical charge.

4 3 2 1 d. Compare the relative hazards of alphas, betas and gammas by

identifying what it takes to "stop" them.

4 3 2 1 e. Define "element," "isotope," "nuclide," "atomic number" and "mass number."

4 3 2 1 f. Explain the meaning of the symbols used to identify different nuclides.

4 3 2 1 g. Describe what is meant by "fission" and "fusion."

4 3 2 1 h. Use Einstein's equation, $E = mc^2$, to change mass to energy.

4 3 2 1 i. Identify workplace applications where technicians work with nuclear radiation.

4 3 2 1 j. Describe safety procedures that technicians must follow when working with nuclear radiation.

UNIT 13: LIGHT AND OPTICAL SYSTEMS

SUBUNIT 1: RAY OPTICS: RELECTION AND REFRACTION

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Explain what is meant by the "reflection" of light.

4 3 2 1 b. Use light rays in a drawing to show how light is reflected from plane (flat) mirrors.

4 3 2 1 c. Use light rays in a drawing to show how light is reflected from spherical mirrors.

4 3 2 1 d. Explain what is meant by the "curvature" and "focal length" of a mirror.

4 3 2 1 e. Use light rays to trace light from an object to a mirror and on to the image formed by the mirror.

4 3 2 1 f. Explain what is meant by the "refraction" of light.

4 3 2 1 g. Define what is meant by the "index of refraction."

4 3 2 1 h. Use light rays in a drawing to show how light is refracted at an optical boundary between air and water or air and glass.

4 3 2 1 i. Use light rays in a drawing to show how lenses bend and focus light.

4 3 2 1 j. Explain what is meant by the size and focal length of a lens.

4 3 2 1 k. Use light rays to trace light from an object to a lens and on to an image formed by the lens.

4 3 2 1 l. Distinguish between convex and concave lenses.

4 3 2 1 m. Identify workplace applications where technicians use ray

optics.

SUBUNIT 2: WAVE OPTICS: INTERFERENCE AND DIFFRACTION

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Describe the difference between "shadows" caused by light rays and by light waves.
4 3 2 1 b. Explain how light "interferes" with itself when waves overlap at a point.
4 3 2 1 c. Distinguish between "constructive" and "destructive" interference.
4 3 2 1 d. Describe what is meant by "interference fringes."
4 3 2 1 e. Identify workplace applications where technicians use "interference of light."
4 3 2 1 f. Explain what is meant by "diffraction."
4 3 2 1 g. Explain what is meant by "collimated" light.
4 3 2 1 h. Explain why light spreads as it travels.
4 3 2 1 i. Explain what is meant by a diffraction grating.
4 3 2 1 j. Explain what a grating spectrometer does.
4 3 2 1 k. Identify workplace applications where technicians use "diffraction of light."

SUBUNIT 3: LASER LIGHT

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Identify the three main components of a laser.
4 3 2 1 b. Draw simple block diagram of a laser.
4 3 2 1 c. List four ways to put energy into a laser.
4 3 2 1 d. List three main types of lasers.
4 3 2 1 e. Identify, by name or symbol, five important lasers.
4 3 2 1 f. List three important characteristics of laser light.
4 3 2 1 g. Describe what is meant by "coherent light."
4 3 2 1 h. Define "radiant power" and "power density."
4 3 2 1 i. Explain why lasers can produce extremely high power densities on targets.
4 3 2 1 j. Identify workplace applications where technicians use lasers.

SUBUNIT 4: OPTICAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Describe how the human eye forms an image of light.
4 3 2 1 b. Use light rays to show why an eye is "nearsighted."
4 3 2 1 c. Use light rays to show why an eye is "farsighted."
4 3 2 1 d. Show how lenses are used to correct for nearsighted or farsighted vision.
4 3 2 1 e. Describe how a camera forms an image on film.
4 3 2 1 f. Describe what is meant by the "f-number" of a camera lens.
4 3 2 1 g. Describe how a simple "beam-expander" works.
4 3 2 1 h. Describe an optical system containing lasers and fiber optics that can be used in hospital operating rooms.
4 3 2 1 i. Describe an optical laser ranging system that can project a laser beam onto the moon and detect the return signal.
4 3 2 1 j. Describe a laser system that can be used for welding.

UNIT 14: TIME CONSTANTS

SUBUNIT 1: TIME CONSTANTS IN MECHANICAL AND FLUID SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Draw a curve that shows a "linear" increase or decrease of a variable with time.
4 3 2 1 b. Draw a curve that shows an "exponential" increase or decrease of a variable with time.
4 3 2 1 c. Identify the time constant in a given mathematical equation that expresses an exponential change.
4 3 2 1 d. Explain why--for all practical purposes--a time interval of "five time constants" can be used to signify the "completion" of an exponential change process.
4 3 2 1 e. Given the equation that describes how fast a vibration is slowing down (damped oscillation), identify the time constant. Predict when the vibration is about 99% damped out.

4 3 2 1 f. Given the equation that describes how fast a tank is emptied, identify the time constant. Predict when the tank will be about 99% empty.

4 3 2 1 g. Identify workplace applications where technicians measure and control time constants in mechanical and fluid systems.

SUBUNIT 2: TIME CONSTANTS IN ELECTRICAL AND THERMAL SYSTEMS

Upon completion of this unit, the student will be able to:

4 3 2 1 a. Draw a curve that shows how voltage increases with time while charging a capacitor.

4 3 2 1 b. Given the equation that describes the charging of a capacitor, identify the 1/e time constant and predict when the capacitor will be 99% charged.

4 3 2 1 c. Draw a curve that shows how voltage decreases with time in the process of discharging a capacitor.

4 3 2 1 d. Given the equation that describes the discharging of a capacitor, identify the 1/e time constant and predict when the capacitor will be 99% discharged.

4 3 2 1 e. Give the equation that describes the increase in current through an inductor when a switch is closed, identify the 1/e time constant and predict the time it takes for the current to reach 99% of its final value.

4 3 2 1 f. Draw a curve that represents the cooling rate of an isolated container of hot liquid located in a room at some cooler temperature (T).

4 3 2 1 g. Given the equation describing the cooling rate of an isolated container or object, identify the 1/e time constant and predict when the hot substance will complete 99% of its cooling process.

4 3 2 1 h. Explain why it is important to know the time constant of a thermocouple.

4 3 2 1 i. Identify workplace applications in electrical and thermal systems where technicians measure or control time constants.

APPENDIX B

LIST OF EQUIPMENT AND SUPPLIES FOR
PRINCIPLES OF TECHNOLOGY I AND II BY UNIT

PRINCIPLES OF TECHNOLOGY

UNIT 1 - FORCE

CORD ITEM #	ITEM NAME & DESCRIPTION	QUANTITY	PER STATION COST UNIT	PER STATION COST EXTENSION	PER LAB COST UNIT	PER LAB COST EXTENSION
1.0*	SLS-1 HEAVY DUTY SUPPORT STAND 1/2" galvanized pipe, 6' tall x 36" wide.	1/STA	$75.00	$ 75.00		
2.0*	SLS-2 FORCE BEAM - Solid 2 x 6 beam with 6 eyebolts for item 11.	1/STA	25.00	25.00		
3.0	SLS-3 SPRING BALANCE- 0-25 Lbs	3/STA	8.00	24.00		
4.0	SLS-4 CONTAINER - 1 gal w/lid	1/STA	2.25	2.25		
5.0	SLS-5 CHAIN & CORD	1/STA	4.50	4.50		
6.0	SLS-6 KEY CHAIN RING	1/STA	.75	.75		
7.1	SLL-7.1 RULER, 12pk.	1/LAB			$ 4.55	$ 4.55
7.2	SLS-7.2 PROTRACTOR	1/STA	.78	.78		
8.1	SLS-8.1 CALIPER, VERNIER	1/STA	5.95	5.95		
8.2	SLS-8.2 CALIPER, BOW	1/STA	6.17	6.17		
9-10*	SLS-9-10 SPRING HOLDER JIG Heavy Duty Acrylic, includes dowel rod and heavy duty spring rated 5 lbs. per one inch extension: maximum 15 lbs.	1/STA	20.00	20.00		
11.0	SLS-11 LARGE WEIGHT HANGER	1/STA	20.34	20.34		

CORD ITEM #	ITEM NAME & DESCRIPTION	QUANTITY	PER STATION COST UNIT	PER STATION COST EXTENSION	PER LAB COST UNIT	PER LAB COST EXTENSION
12.0	SLS-12 LARGE SLOTTED WEIGHT SET - 1-5 Kg, 1-2 Kg, 2-1 Kg, and 1-0.5 Kg	1/STA	$102.42	$ 102.42		
13.0	SLS-13 C-CLAMPS - Two Small, One Large	3/STA	6.18	18.54		
14.0	SLS-14 HYDROMETER, Scaled	1/STA	9.00	9.00		
15.0	SLS-15 HYDROMETER, Pocket	1/STA	2.00	2.00		
16.0	SLS-16 BEAKER, 600 Ml	4/STA	3.00	12.00		
17.0	SLS-17 U-TUBE MANOMETER -w/dye	1/STA	33.67	33.67		
18.0	SLS-18 MANUAL VACUUM/ PRESSURE PUMP	1/STA	45.60	45.60		
19.0	SLS-19 TUBING - 2 - 4 Ft. Sections of 1/4", 2 - 4 Ft. Sections of 1/2", 1 - 3 Ft. Section of 3/8"	1/STA	10.00	10.00		
20.0*	SLS-20 AIR CHAMBER ASSEMBLY Constructed with schedule 40 PVC with industrial grade fittings and tubing barbs	1/STA	10.00	10.00		
21.0	SLS-21 PRESSURE GAUGE - Compound type	2/STA	8.78	17.56		
22.0*	SLS-22 ACCUMULATOR 1 1/4" I.D. clear tubing w/1 1/4" endsand 1/2" male pipe connection.	1/STA	20.00	20.00		
23.0	SLS-23 ANALOG METER	1/STA	39.00	39.00		
24.0	SLS-24 UNIVERSAL LEADS	1/STA	20.80	20.80		

CORD ITEM #	ITEM NAME & DESCRIPTION	QUANTITY	PER STATION COSTS UNIT	PER STATION COSTS EXTENSION	PER LAB COST UNIT	PER LAB COST EXTENSION
25.0	SLS-25 BATTERY, Dry cell 6-volt	3/STA	$ 3.72	$ 11.16		
25.1	SLS-25.1 BATTERY Transistor 9-volt	1/STA	1.60	1.60		
26.0	SLL-26 BATTERY Wet Cell	1/LAB			$ 25.35	$ 25.35
27.0	SLS-27 DIGITAL MULTIMETER	1/STA	69.00	69.00		
28.0	SLS-28 SWITCH, SPST	2/STA	2.28	4.56		
29.0	SLS-29 MINATURE LAMP BASES	2/STA	3.85	7.70		
30.0	SLS-30 MINATURE LAMPS	2/STA	.93	1.86		
31.0	SLS-31 SCALED THERMOMETER	2/STA	6.12	12.24		
32.0	SLS-32 BLANK THERMOMETER	2/STA	4.64	9.28		
33.0	SLS-33 HOT PLATE	1/STA	94.25	94.25		
34.0	SLS-34 THERMOMETER CLAMP	2/STA	6.90	13.80		
35.0	SLS-35 SUPPORT STAND SET UP to include the following: 2 Bases, 1-Clamp Base, 2-Threaded Rods 1/2" x 36", 1-Threaded Rod 1/2" x 24", 2-Right Angle Clamps, 1-Adjustable Angle Clamp, 4-Unthreaded Rods 1/2" x 24", 1-Three Finger Clamp	1/STA	136.45	136.45		
36.0	SLL-36 THERMOCOUPLE SET	1/LAB			67.50	67.50
D1	SLD-1 SUCTION CUPS	1/LAB			11.70	11.70
D2	SLD-2 SOCKET FIXTURE	1/LAB			19.50	19.50
D3	SLD-3 TORQUE WRENCH	1/LAB			25.00	25.00

CORD ITEM #	ITEM NAME & DESCRIPTION	QUANTITY	PER STATION COSTS UNIT	PER STATION COSTS EXTENSION	PER LAB COST UNIT	PER LAB COST EXTENSION
D4	SLD-4 ASPIRATOR BOTTLE	1/LAB			$ 39.26	$ 39.26
D5	SLD-5 FLOW INDICATOR	1/LAB			8.88	8.88
D6	SLD-6 THERMAL BAR	1/LAB			23.40	23.40
D7	SLD-7 THERMAL CRAYON-69, 83, 101 degrees	1/LAB			25.35	25.35
D8	SLD-8 PARAFFIN	1/LAB			3.75	3.75
D9	SLD-9 INSULATOR SQUARES	1/LAB			9.00	9.00
			TOTAL	$ 887.23]		$263.24]

CORD ITEM #	ITEM NAME & DESCRIPTION	QUANTITY	PER STATION COSTS UNIT	PER STATION COSTS EXTENSION	PER LAB COST UNIT	PER LAB COST EXTENSION
37.0	PULLEY SET					
37.1	SLS-37.1 SINGLE SHEAVE PULLEY	3/STA	$ 2.73	$ 8.19		
37.2	SLS-37.2 DOUBLE SHEAVE PULLEY	2/STA	3.51	7.02		
37.3	SLS-37.3 TRIPLE TANDEN PULLEY	2/STA	5.53	11.06		
37.4	SLS-37.4 STEPPED PULLEY W/AXLE	1/STA	19.37	19.37		
37.5	SLS-37.5 SINGLE SHEAVE PULLEY HEAVY DUTY	1/STA	2.91	2.91		
37.6	SLS-37.6 PULLEY CORD	1/STA	2.54	2.54		
38.0	SLS-38 SPRING BALANCE SET 0-2.5N/0-5N/0-20N	1/STA	18.72	18.72		
39.0	SLS-39 MONOFILAMENT LINE	1/STA	6.00	6.00		
40.0	SLS-40 SMALL CAPACITY SLOTTED WEIGHTS	1/STA	57.55	57.55		
41.0	SLS-41 WEIGHT HANGER - 50g	2/STA	4.32	8.64		
42.0	SLS-42 METER STICK	1/STA	3.25	3.25		
43.0*	SLS-43 WINCH ASSEMBLY	1/STA	80.00	80.00		
44.0	SLS-44 LARGE PNUEMATIC CYLINDER	1/STA	26.00	26.00		
45.0*	SLS-45 WEIGHT STAGE	1/STA	7.50	7.50		
46.0	SLS-46 WATER PUMP, Motor Driven	1/STA	50.00	50.00		
47.0	SLS-47 POWER SUPPLY, AC/DC	1/STA	425.00	425.00		
48.0	SLS-48 HOSES, For Water Pump		Included in Item #46.			
49.0	SLS-49 BEAKER, 1000 Ml	2/STA	4.54	9.08		

UNIT 2 - WORK

CORD ITEM #	ITEM NAME & DESCRIPTION	QUANTITY	PER STATION COSTS UNIT	PER STATION COSTS EXTENSION	PER LAB COSTS UNIT	PER LAB COSTS EXTENSION
50.0	SLS-50 LARGE CAPACITY CONTAINERS	2/STA	$ 5.20	$ 10.40		
51.0	SLS-51 STOPWATCH	1/STA	18.00	18.00		
52.0*	SLS-52 ELECTRIC MOTOR ASSEMBLY 1/16 H.P., 12 VDC 8 amp motor, 3/8" output shaft, stand made of 3/4" plywood	1/STA	97.50	97.50		
53.0	SLS-53 SWITCH, SPST, pushbutton	1/STA	1.50	1.50		
54.0*	SLS-54 SOLENOID ASSEMBLY Solenoid w/2 binding posts and prewired on heavy duty acrylic stand.	1/STA	31.00	31.00		
	PULLEY SET - Necessary for experiments using Motor Assembly #52	1/STA	19.50	19.50		
		TOTAL		$ 9207.73		

CORD ITEM #	ITEM NAME & DESCRIPTION	QUANTITY	PER STATION COSTS UNIT	PER STATION COSTS EXTENSION	PER LAB COSTS UNIT	PER LAB COSTS EXTENSION
55.0*	SLS-55 CONVEYOR BELT ASSEMBLY Includes, 3/4" Formica covered plywood construction.	1/STA	$ 50.00	$ 50.00		
56.0	SLL-56 TRIPLE BEAM BALANCE	3/LAB			$ 94.33	$ 282.99
57.0	SLS-57 STROBOSCOPE	1/STA	145.15	145.15		
58.0*	SLS-58 WATER CHANNEL ASSEMBLY	1/STA	70.00	70.00		
59.0	SLS-59 AIR STORAGE TANK	1/STA	50.70	50.70		
60.0	SLS-60 AIR PRESSURE REGULATOR Regulator mounted to heavy duty acrylic stand.	1/STA	55.00	55.00		
61.0*	SLS-61 COLLECTION COLUMN APPARATUS	1/STA	20.00	20.00		
61.1	SLS-61 WATER BATH	1/STA	3.00	3.00		
62.0*	SLS-62 ORIFICE SET-UP Includes tubing, 3 teflon tees, clamps, and orifice assembly.	1/STA	30.00	30.00		
63.0	SLS-63 TUBING CLAMPS Four stainless and one stepped.	1/STA	3.25	3.25		
64.0	SLS-64 LAMP SOCKET	Use Heat Transfer Assembly #68				
64.1	SLS-64.1 HEATER	Use Heat Transfer Assembly #68				
65.0	SLS-65 OSCILLOSCOPE - 20 MHZ, Dual Trace.	1/STA	491.00	491.00		
66.0	SLS-66 FUNCTION GENERATOR 2 MHZ; Sine, Square, Triangle	1/STA	219.00	219.00		

CORD ITEM #	ITEM NAME & DESCRIPTION	QUANTITY	PER STATION COSTS UNIT	PER STATION COSTS EXTENSION	PER LAB COSTS UNIT	PER LAB COSTS EXTENSION
67.0	SLS-67 DEWAR FLASK	1/STA	$115.00	$ 115.00		
68.0*	SLS-68 HEAT TRANSFER ASSEMBLY	1/STA	40.00	40.00		
69.0	SLS-69 SWITCH, DPDT, Knife	1/STA	3.50	3.50		
70.0	SLS-70 CONTAINERS - 3 - 1 Lb. cans; 2 - 3 Lb. cans.	1/STA	7.80	7.80		
D10	SLD-10 TOY CAR w/batteries	1/LAB			$ 7.50	$ 7.50
D11	CARDBOARD DISK		Make			
D12	BEAKERS, 1000 Ml		Already purchased			
			TOTAL	$ 1,303.40		$ 290.49

CORD ITEM #	ITEM NAME & DESCRIPTION	QUANTITY	PER STATION COSTS UNIT	PER STATION COSTS EXTENSION	PER LAB COSTS UNIT	PER LAB COSTS EXTENSION
71.0*	SLS-71 LARGE FRICTION PLATE	1/STA	$ 7.00	$ 7.00		
72.0*	SLS-72 SMALL FRICTION PLATE	1/STA	5.00	5.00		
73.0*	SLS-73 AIR FLOW ASSEMBLY Plexiglass tube 24" x 2"	1/STA	46.00	46.00		
74.0	OBJECTS		INCLUDED IN ITEM 73.0			
75.0	SLS-75 AIR SOURCE	1/STA	62.40	62.40		
75.1	Shop Vacuum	1/STA	INCLUDED IN ITEM #75.0			
75.2	Hose	1/STA	INCLUDED IN ITEM #75.0			
76.0	DUCT TAPE	1/STA	6.00	6.00		
77.0	VALVES	1/STA	12.00	12.00		
78.0	GARDEN HOSE SET	1/LAB			$ 37.50	$ 37.50
78.1	Large		INCLUDED IN 78.0			
78.2	Small		INCLUDED IN 78.0			
79.0*	RESTRICTOR PLATES	1/STA	18.00	18.00		
80.0	FILTER SECTIONS	1/STA	2.00	2.00		
81.0	SOLDERLESS BREADBOARD	1/STA	9.50	9.50		
82.0	FIXED RESISTOR ASSORMENT	1/STA	22.00	22.00		
83.0	VARIABLE RESISTOR ASSORTMENT	1/STA	INCLUDED IN 82.0			
84.0	WIRE SEGMENTS	1/LAB	14.00	14.00		
85.0*	THERMAL PIPE ASSEMBLY	1/STA	84.00	84.00		

UNIT 4: RESISTANCE

CORD ITEM #	ITEM NAME & DESCRIPTION	QUANTITY	PER STATION COSTS UNIT	PER STATION COSTS EXTENSION	PER LAB COSTS UNIT	PER LAB COSTS EXTENSION
86.0	SLL-86 FUNNEL, 12 pk				$ 5.27	$ 5.27
D13*	SLD-13 WEIGHTED BLOCKS				10.00	10.00
D14*	SLD-14 FLOW SHROUD				46.00	46.00
D15	SLD-15 SLANT TUBE MANOMETER				17.45	17.45
	Stand for Manometer				10.00	10.00
D16	SLD-16 AUTO AIR FILTER				INCLUDED IN ITEM SLD-14	
D17*	SLD-17 RESISTANCE BOARD				26.00	26.00
D18*	SLD-18 CHIMNEY ASSEMBLY				18.20	18.20
	TOTAL		$ [illegible]			$170.42

CORD ITEM #	ITEM NAME & DESCRIPTION	QUANTITY	PER STATION COSTS UNIT	PER STATION COSTS EXTENSION	PER LAB COSTS UNIT	PER LAB COSTS EXTENSION
87.0*	SLS-87 SPRING TEST APPARATUS - includes spring; completely unitized for easy inventory control and measurements	1/STA	$ 25.00	$ 25.00		
88.0*	SLS-88 FLYWHEEL APPRATUS Heavy cast 8" diameter flywheel, 5/8" bearing and shaft; Includes friction assembly	1/STA	150.00	150.00		
89.0	SLS-89-90 AIR MOTOR	1/STA	112.00	112.00		
90.0	STIRRING ATTACHMENT		INCLUDED IN ITEM #89			
91.0	SLS-91 HYDRAULIC FLOW & SHOCK ASSEMBLY	1/STA	50.00	50.00		
92.0	SLL-92 STRIP CHART RECORDER	1/LAB			$ 750.00	$ 750.00
93.0	SLS-93 ROTAMETER	1/STA	61.75	61.75		
94.0	SLS-94 SPECIFIC HEAT SAMPLE KIT	1/STA	19.44	19.44		
95.0	SLS-95 TONGS	1/STA	4.55	4.55		
D19	SLD-19 STYROFOAM BOARD	1/LAB			2.00	2.00
D20	SLD-20 CAPACITOR	1/LAB			3.00	3.00
D21	SLD-21 PIPE ASSEMBLY	1/LAB			25.00	25.00
			TOTAL	$422.74		$ 780.00

CORD ITEM #	ITEM NAME & DESCRIPTION	QUANTITY	PER STATION COSTS UNIT	PER STATION COSTS EXTENSION	PER LAB COSTS UNIT	PER LAB COSTS EXTENSION
96.0	FRICTION ASSEMBLY	1/STA	INCLUDED WITH FLYWHEEL ASSEMBLY #80			
97.0	SLS-97 PIPE TEES WITH TAPS	2/STA	$ 7.50	$ 15.00		
98.0	SLL-98 KILOWATT/HOUR ASSEMBLY	2/LAB			$350.00	$ 700.00
99.0	SLS-99 MOTOR/GENERATOR SET	1/STA	130.00	130.00		
			TOTAL	$ 145.00		$ 700.00

UNIT 7: FORCE TRANSFORMERS

CORD ITEM #	ITEM NAME & DESCRIPTION	QUANTITY	PER STATION COSTS UNIT	PER STATION COSTS EXTENSION	PER LAB COSTS UNIT	PER LAB COSTS EXTENSION
100.0	SLS-100 COME-A-LONG WINCH	1/STA	$ 60.00	$ 60.00		
101.0*	SLS-101 PIPE-VISE ASSEMBLY	1/STA	45.00	45.00		
102.0	SLS-102 SPUR GEARS WITH SHAFT	1/STA	68.25	68.25		
103.0	SLS-103 GEAR TRAIN ASSEMBLY	1/STA	81.90	81.90		
104.0*	SLS-104 BELT DRIVE ASSEMBLY	1/STA	100.00	100.00		
105.0	SLS-105 HYDRAULIC JACK with 5000 lb pressure gage	1/STA	100.00	100.00		
106.0	SLS-106 PRESSURE STAGE	1/STA	55.00	55.00		
107.0	SLS-107 SMALL PNEUMATIC CYLINDER includes barbs	1/STA	23.00	23.00		
108.0	SLS-108 TRANSFORMER ASSEMBLY	1/STA	30.00	30.00		
109.0	VARIAC	1/STA	NOT NECESSARY - #47 IS AC/DC			
110.0	STEP-DOWN TRANSFORMER	1/STA	NOT NECESSARY - #47 IS AC/DC			
111.0	SLS-111 MAGNET WIRE	1/LAB			$ 13.00	$ 13.00
		TOTAL		$563.15		$ 13.00

*Prices subject to change without notice. Prices do not include freight.

PRINCIPLES OF TECHNOLOGY

UNIT 8: MOMENTUM

Record Item	Item Name & Description	Quantity	Per Station Costs Unit	Per Station Costs Extension	Per Lab Costs Unit	Per Lab Costs Extension
200.0	SLS-200 IMPULSE MEASURING ASSEMBLY	1/STA	$170.00	$ 170.00		
201.0	SLS-201 MOMENT OF INTERIA	1/STA	160.00	160.00		
202-204	SLS-202-204 FLUID MOMENTUM ASSEMBLY	1/STA	50.00	50.00		
			Total	380.00		

UNIT 9: WAVES AND VIBRATIONS

Cord Item#	Item Name & Description	Quanity	Per Station Costs Unit	Per Station Costs Extension	Per Lab Costs Unit	Per Lab Costs Extension
205.0	Torsion Rod Assembly	Deleted by Cord				
206.0	SLS-206 MECHANICAL SHOCK ASSEMBLY	1/STA	$132.00	$132.00		
207.0	SLS-207 VIBRATION TRANSDUCER	2/STA	295.00	590.00		
207.1	SLS-207.1 BNC CABLES	2/STA	12.50	25.00		
208.0	SLS-208 BATTERY PACK	2/STA	11.00	22.00		
209.0	SLS-209 SPEAKER AND AUDIO TRANSFORMER	1/STA	7.50	7.50		
210.0	SLS-210 MICROPHONE	1/STA	5.00	5.00		
211.0	SLS-211 RESONANCE TUBE	1/STA	13.10	13.10		
212.0	SLS-212 INDUCTOR SET	Deleted by Cord				
213.0	SLS-213.0 CAPACITOR SET	1/STA	3.00	3.00		
			Total	797.60		

UNIT 10: ENERGY CONVERTORS

Cord Item #	Item Name & Description	Quanity	Per Station Costs Unit	Per Station Costs Extension	Per Lab Costs Unit	Per Lab Costs Extension
214.0	SLS-214 WIND GENERATOR ASSEMBLY	1/STA	$210.00	$210.00		
215.0	SLS-215 ANEMOMETER	1/STA	$ 52.00	52.00		
216.0	SLS-216 SOLAR CELL PANELS	2/STA	13.50	27.00		
217.0	SLS-217 FLOOD LAMP ASSEMBLY With bulb	1/STA	30.00	30.00		
218.0	SLS-218 PHOTOMETER	1/STA	130.00	130.00		
219.0	SLS-219 PARABOLIC REFLECTOR	1/STA	30.00	30.00		
220.0	AIR THERMOMETER BULB	Deleted by CORD				
221.0	SLS-221 THERMOELECTRIC GENERATOR SET	1/STA	149.00	149.00		
222.0	SLS-222 LASER, HE-NE	1/STA	310.00	310.00		
223.0	SLS-223 HV POWER SUPPLY	(See Unit 12)				
224.0	SLS-224 SPECTRUM TUBE SET	(See Unit 12)				
225.0	SLS-225 MINATURE FLOURESCENT LIGHT SOURCE With Batteries	1/STA	33.00	33.00		
226.0	SLS-226 STEAM ENGINE	1/STA	79.00	79.00		
227.0	SLS-227 AC WATTMETER	1/STA	170.00	170.00		
			Total	$1,220.00		

UNIT 11: TRANDUCERS

Cord Item #	Item Name & Description	Quantity	Per Station Costs Unit	Per Station Costs Extension	Per Lab Costs Unit	Per Lab Costs Extension
228.0	SLS-228 LOAD CELL ASSEMBLY	1/STA	$ 61.00	$ 61.00		
229.0	SLS-229 LVDT W/ACCESSORY ROD	1/STA	212.00	212.00		
231.0	SLS-231 PRESSURE MANIFOLD ASSEMBLY	1/STA	100.00	100.00		
232.0	SLS-232 DIFFERENTIAL PRESSURE CELL	1/STA	55.00	55.00		
233.0	SLS-233 LIQUID FLOW ORIFICE ASSEMBLY	1/STA	11.00	11.00		
234.0	SLS-234 BIMETALLIC STRIP ASSEMBLY	1/STA	19.00	19.00		
235.0	SLS-235 THERMISTOR	1/STA	13.00	13.00		
236.0	SLS-236 PRT	1/STA	23.00	23.00		
237.0	SLS-237 SOLID STATE TEMPERATURE SENSOR	1/STA	77.00	77.00		
			Total	571.00		

UNIT 12: RADIATION

Cord Item #	Item Name & Description	Quantity	Per Station Costs Unit	Per Station Costs Extension	Per Lab Costs Unit	Per Lab Costs Extension
223.0	SLS-223 HV POWER SUPPLY	1/STA	$112.00	$112.00		
224.0	SLS-224.1 SPECTRUM TUBE, HELIUM	1/STA	14.00	14.00		
224.2	SLS-224.2 SPECTRUM TUBE, HYDROGEN	1/STA	14.00	14.00		
224.3	SLS-224.3 SPECTRUM TUBE, MERCURY	1/STA	14.00	14.00		
224.4	SLS-224.4 SPECTRUM TUBE, NEON	1/STA	12.50	12.50		
224.5	SLS-224.5 SPECTRUM TUBE, NITROGEN	1/STA	10.50	10.50		
238.0	SLS-238 STUDENT SPECTROSCOPE	1/STA	4.75	4.75		
D13	SLD-13 PARTICLE RADIATION DEMO	1/LAB			$800.00	$800.00
			Total	$181.75	Total	$800.00

UNIT 13: OPTICS AND OPTICAL SYSTEMS

Cord Item #	Item Name & Description	Quantity	Per Station Costs Unit	Per Station Costs Extension	Per Lab Costs Unit	Per Lab Costs Extension
240.0	SLS-240 LAZY SUSAN OPTICS TABLE	1/STA	$ 50.00	$ 50.00		
241.0	SLS-241 COOLER FILTER SET	1/STA	250.00	250.00		
242.0	SLS-242 LENS SET, to include Positive long FL, Positive short FL, Negative, Cylindrical	1/STA	Included in #241			
243.0	SLS-243 SCREEN	1/STA	Included in #241			
244.0	SLS-244 DIFFERACTION GRATING	1/STA	Included in #241			
246.0	SLS-246 POLARIZED FILTER SET	1/STA	Included in #241			
250-251	SLS-251 FIBER OPTICS SET	1/STA	49.00	49.00		
			Total	349.00		

CORD ITEM #	QTY.	ITEM NAME	ITEM SPECIFICATIONS
200	1/STA	IMPULSE MEASUREMENT ASSEMBLY	Constructed with sturdy wood base, 6" PVC pipe mounted on base with spring and rod enclosed. No styrofoam necessary with this simplified design. Attaches to SLS-1 Heavy Duty Support Stand using flat iron brackets. Included with assembly is another spring of different pound per inch extension, support brackets, impact plate and necessary mounting hardware. Measurements to be 24"L x 12"H x 12"W.
201	1/STA	MOMENT OF INERTIA ASSEMBLY	Constructed of heavy duty plexiglass with its own motor mounted for direct drive. No pulleys necessary. Rotating rod with movable weights held tightly in place by coiter pins and nuts on both ends of the rod for safety. Must be separate unit, not part of belt-drive assembly.
202-204	1/STA	FLUID MOMENTUM ASSEMBLY	Two flexible hose sections with 90 degree PVC elbows, slider assembly, all necessary PVC tees and hose connectors mounted on 24" x 24" sturdy plywood base.
206	1/STA	MECHANICAL SHOCK ASSEMBLY	Constructed of heavy duty plexiglass with upper and lower platform suspended by wire.

CORD ITEM #	QTY.	ITEM NAME	ITEM SPECIFICATIONS
			Lower plate includes drive bar to connect to SLS-52 Electric Motor Assembly. Assembly to include small innertube and holder for slotted weights.
207	2/STA	VIBRATION TRANSDUCERS	Range (for +/- output) 250 +/-G Resoulution .005G Useful Overrange 350G Sensitivity (Nominal) 20mV/G Resonant Freq.(MTD) 12kHz Freq. Range 1-5000Hz Discharge Time Constant 0.5 Sec. Amplitude Linearity 1.0%FS Polarity Pos. Output Impedance 100ohm Output Bias (nominal) 13V+ Overload Recovery 10uSec Transverse Sens 10% Strain Sensitivity .05 G/uin/in Temp. Range -50 to +150 F Temp. Coefficient .03%/F Vibration (max) 500 Shock (max) 1000 G Structure Upright Size (hex x height) .62x.95" Sealing Epoxy Case Material St Stl Weight 30 gm Connector (micro) 10-32 Ground Isolation No Excitation 24-27/2-20 +VDC/mA Power Conditioner also included.
207.1	2/STA	BNC CABLES	24" Long BNC to BNC connectors.
208	2/STA	BATTERY	22.5 Volt

CORD ITEM #	QTY.	ITEM NAME	ITEM SPECIFICATIONS
209	1/STA	SPEAKER	3" wide frequency range speaker
209.1	1/STA	AUDIO TRANSFORMER	1000 ohm CT transformer
210	1/STA	MICROPHONE	Omnidirectional 30 Hz to 15 kHz range with 4-10 VDC power.
211	1/STA	RESONANCE TUPE	2" id x 2' long plexiglass.
213	1/STA	CAPACITOR SET	Three 47 pF nonelectrolytic, one 10 mF electrolytic.
214	1/STA	WIND GENERATOR ASSEMBLY	Output assembly to consist of lawn/leaf blower mounted on plexiglass base. Flow tube approx. 2' long. Output assembly to consist of fan, motor and light. Overall dimensions 36"L x 8"W x 12"H.
215	1/STA	ANEMOMETER	Mark II Slant Tube Manometer with 50 foot of vinyl tubing and weather vane included.
216	2/STA	SOLAR CELL PANEL	6 Volt at 50 mA under full sun. Dimensions 4"L x 1/2"W x 6"H.
217	1/STA	FLOOD LAMP ASSEMBLY	Light fixture with reflector and 300 W lamp bulb.
218	1/STA	PHOTOMETER	Laser Power Meter type with range 0.003mW to 10.0mW. Metrologic 45-230.
219	1/STA	REFLECTOR	Parabolic, 18" diameter, metal.
221	1/STA	THERMOELECTRIC MODULE ASSEMLBY	Assembly to be constructed of plexiglass with two aluminum blockes drilled for temperature chambers, and insulated with styrofoam blocks. Thermoelectric module to be sandwiched between aluminum blocks. Thermoelectric module assembly to be 6"L x 6"H x 3 1/2"W.

CORD ITEM #	QTY.	ITEM NAME	ITEM SPECIFICATIONS
222	1/STA	LASER	Helium-Neon with output power of 0.5 mW. Novette 1508.
223	1/STA	HV POWER SUPPLY	Spectrum Tube power supply with heavy duty plastic enclosure to protect against shock. Operates standard 10.5 inch spectrum tubes. Operates on 115V AC.
224	1/STA	SPECTRUM TUBE SET	To consist of the following: 1 - SLS-224.1 Hydrogen 1 - SLS-224.2 Helium 1 - SLS-224.3 Nitrogen 1 - SLS-224.4 Neon 1 - SLS-224.5 Mercury Vapor
225	1/STA	FLOURESCENT FIXTURE	120 V 12W fixture that screws into standard light bulb fixture. To be powered by power supply.
226	1/STA	STEAM ENGINE	Horizontal boiler, double acting, oscillationg cylinder mounted on 8 3/4" metal base. Solid brass boiler 2 1/2" diam. by 6" long nickle plated and polished, electrically heated and equipped with water gauge, safety valve, whistle and two speed power take-off pulley. The double acting oscillating brass cylinder engine with 3" diameter flywjeel is vertically mounted on anickel plated bracket. Engine partes in nickel plate.
227	1/STA	AC WATTMETER	To have two panel meters AC Ammeter 0-15 VAC and AC Voltmeter. 1000W range.

CORD ITEM #	QTY.	ITEM NAME	ITEM SPECIFICATIONS
228	1/STA	LOAD CELL ASSEMBLY	To include two strain guages, output board, load member and connecting cable. Built to CORD specifications.
229	1/STA	LVDT WITH ACCESSORY ROD	Input +/- 24VDC, Range +/-1.0", Output load 1 Mohm, AC Ripple <25 mv (max.). Length 4.25", Diam. .250 inch, thread 6-40. Accessory rod included.
231	1/STA	PRESSURE MANIFOLD ASSEMBLY	Constructed of heavy duty plexiglass with schedule 40 PVC and all brass fitting and reducers necessary to perform experiments.
232	1/STA	DIFFERENTIAL PRESSURE CELL	Excitation: 10V dc (16V dc Max) Output: 15 PSI - 0 to 100 mV Sensitivity: 15 PSI - 10 mV/V Input Impedance: 8K ohm Output Impedance: 5K ohm
233	1/STA	LIQUID FLOW ORIFICE ASSEMBLY	Construced of schedule 40 PVC with all necessary brass fittings.
234	1/STA	BIMETALLIC STRIP ASSEMBLY	Bi-metal strip, vertically mounted. Electrical contact closes when heated or can reversed to open. Adjustable temperature control. Binding posts attached.
235	1/STA	THERMISTOR	+/- 0.2 degrees accuracy 2,252 ohms resistance at 25 degrees C.
236	1/STA	PLATINUM RESISTANCE THERMOMETER (PRT)	Nominal Resistance 1 x 100 ohms. Temperature Range: -200 to +750 degrees C.

CORD ITEM #	QTY.	ITEM NAME	ITEM SPECIFICATIONS
237	1/STA	SOLID-STATE TEMPERATURE SENSOR	Temperature to Analog converter. Linear 1 mV per degree output from thermocouples or RTD. C/F switchable. Built-in Battery Test.
238	1/STA	STUDENT SPECTROSCOPE	Student-type, hand-held with diffraction grating and built-in wavelength scale.
240	1/STA	LAZY SUSAN OPTICS TABLE	12" x 12" wood base, 3" lazy susan bearings, 21" diam. 1/4" fiberboard surface, painted white.
241	1/STA	COLOR FILTER SET	One set of 8 mounted 2" x 2" solid color slides.
242	1/STA	LENS SET	To consist of the following: 1 - Positive long FL - plano-convex lens 33 mm diam. with 233 FL. 1 - Positive short FL - plano-convex lens 32 mm diam. with 58 mm FL. 1 - Negative - plano-concave lens 35 mm diam. with 53 mm FL. 1 - Cylindrical - glass rod 3" long x 4 mm diam.
242.1	1/STA	MIRROR SET	To include the following: 1 - Large flat, front-surface 22mm x 22mm x 5mm. 1 - Small flat, front-surface 8.2 diam. x 1.5 mm.

CORD ITEM #	QTY.	ITEM NAME	ITEM SPECIFICATIONS
242.2	1/STA	BEAM SPLITTER SET	To include the following: 1 - Mirror type 25mm x 38mm x 3mm with 50% transmission & 50% reflect. 1 - Glass Type similar to microscope slide.
242.3	1/STA	PRISM SET	To include the following: 1 - Right Angle 19mm x 19mm x 25mm. 1 - Equilateral 25mmx 25mm. 1 - Dove 76mm x 25mm x 18mm. 1 - Wedge 40mm x 55mm with 10% critical angle.
243	1/STA	SCREEN	Ground glass screen 89mm x 127mm x 3.4 mm.
244	1/STA	DIFFRACTION GRATING	2° x 2° with 13,400 grooves/inch
246	1/STA	POLORIZED NEUTRAL DENSITY	Optical density of 0.5 at 500 nm nominal transmittance =32%.
250	1/STA	FIBER OPTICS SET	Includes Sweet Spot LED and Schmitt Trigger detector, fiber cable, Printed Circuit board and TTL/CMOS driver.
251	1/STA	LED/Photo Diode	One pair of LED and photo diode detectors, IR type.

APPENDIX C

ADVISORY COMMITTEE MEMBERS
AND
MINUTES OF COMMITTEE MEETINGS

LISD/ACC ADVISORY COMMITTEE

Name and Addresses	Telephone No.
BUSINESS AND INDUSTRY NAMES:	
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Mr. Chuck Bradley Cost Center Mgr., Unit Listing Mail Station 2092 Texas Instruments 12337 Technology Blvd. Austin, TX 78727	512-250-6753
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Mr. Leroy Kana Vice President, Product Assurance Tracor, Inc. 6500 Tracor Lane Austin, TX 78725	512-929-2508
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MINUTES

ADVISORY COMMITTEE MEETING
PRINCIPLES OF TECHNOLOGY PROJECT

November 9, 1987
9:30 A.M.

The first year's meeting of the Advisory Committee for the Principles of Technology Project was called to order on November 9, 1987, at 9:30 A.M. at Leander High School.

Linda Hanson, Project Director, welcomed the participants and then introduced Tom Glenn, Superintendent of Leander I.S.D. Mr. Glenn welcomed all in attendance and stressed how much he appreciated the cooperation between the members of the committee and the District.

Mark Kincaid, instructor for Principles of Technology I and II, gave an update on his classes. There are a total of fifty-six (56) students in the PT I class and five (5) juniors are returning as seniors in the PT II class.

Robert Mann, Radian Corporation, asked the percentage of students this involved and what is being done if the same amount of students return this coming year.

With the Principles of Technology courses being a part of the articulation program, Mr. Rouse, Leander High School principal, informed the group that he, Linda Hanson, and Mark Kincaid, would be going to Mountain View College in Dallas on November 17. The Mountain View group is interested in formulating an articulation agreement with secondary schools in their area and wanted to know more about the process.

It was suggested by Linda Hanson that volunteer speakers were needed to come into the PT classes and she asked if there were any business and industry representatives who would be interested. John Rundell of IBM stated that he would try to line up some interested speakers.

Jim O'Connor of Lockheed asked if a PT course outline could be furnished for the Committee members. Ms. Hanson replied that a course outline and

the course time-line would be mailed in December for the committee's review.

Irma Howard, president of Leander I.S.D. Board of Trustees, was then introduced and welcomed the committee from her board perspective.

Linda Hanson asked for suggestions for dates for the future meetings. It was decided by the group that Tuesday mornings would be better and at 9:00 A.M., rather than 9:30 A.M. Meetings will be held in January, March, and the final one in June.

Mark Kincaid thanked IBM and 3M for all of their help with donated equipment. Jim O'Connor with Lockheed asked for a list of needed equipment for the PT classes. This list will be sent to all members in December with the course outline.

The meeting was adjourned by Linda Hanson and an invitation was extended for all committee members to tour the Leander High School facilities.

MINUTES

ADVISORY COMMITTEE MEETING
PRINCIPLES OF TECHNOLOGY PROJECT

JANUARY 26, 1988
9:00 A.M.

The second meeting of the Advisory Committee for Principles of Technology was called to order on January 26, 1988, at 9:00 A.M. at Leander High School. Those in attendance:

Linda Hanson - Leander I.S.D.
Jack Risinger - Texas Education Agency
Casanda Jordan - C.O.R.D.
Bert Marcom - Austin Community College
George Matott - Texas Instruments
Mike Roarke - College and University Coordinating Board
Charles Rouse - Leander High School
Allen Boger - 3M
Chuck Bradley - Texas Instruments
James Cannon - Motorola
Norm Colbath - Austin Community College
Mark Kincaid - Leander High School
Joe Keener - Leander High School
Judy Van Cleve - Austin Community College
Hubert Dixon - Leander High School
Maggie Rice - Leander I.S.D.
Ron Smith - 3M
Walter Stone - KMW Systems Corporation
Dan Hull - C.O.R.D. (Guest)
Alan Sosbe - C.O.R.D. (Guest)
Adriana Barrera - Austin Community College

Mark Kincaid gave an update on his Principles of Technology classes. There are five (5) students in Principles of Technology II and fifty-six (56) enrolled in Principles of Technology I. Of this total, five (5) are females. Dan Hull with the Center for Occupational Research and Development asked if most of the students enrolled had taken Algebra. Hubert Dixon, counselor at Leander High School, stated that one of the

pre-requisites for taking the classes was pre-Algebra. Mark Kincaid also will be teaching a night course for Austin Community College on a modified version of Principles of Technology. That class presently has approximately twenty-five (25) adults enrolled.

George Matott, Texas Instruments, commented on the Governor's Vocational Task Force. Leander High School and the Principles of Technology and 2 + 2 Project were mentioned at the press conference that was given when the Task Force completed its work.

Dan Hull, C.O.R.D., explained the purpose of the Governor's Vocational Task Force and who was involved on the committee. A presentation was given to this committee by representatives of Leander I.S.D. and A.C.C. during the summer on the articulation process between secondary and postsecondary institutions.

Mark Kincaid reported that the "Wish List" submitted to the Advisory Committee in December had already produced two watt meters.

Maggie Rice gave copies of the Education Express to all the committee members. The PT and 2 + 2 has been detailed under "Changes for a Changing World."

The meeting was adjourned by Linda Hanson at 10:30 A.M.

The next meeting will be March 29th at 9:00 A.M.

MINUTES

ADVISORY COMMITTEE MEETING
PRINCIPLES OF TECHNOLOGY PROJECT

MARCH 29, 1988
9:00 A.M.

The third meeting of the Advisory Committee for the Principles of Technology was called to order on Tuesday, March 29, 1988, at 9:00 A.M. Those in attendance were:

Linda Hanson Gray - Leander I.S.D.
James Cogdell - Texas Education Agency
Casanda Jordan - C.O.R.D.
Alan Sosbe - C.O.R.D.
Bert Marcom - Austin Community College
George Matott - Texas Instruments
Charles Rouse - Leander High School
Allen Boger - C.O.R.D.
Chuck Bradley - Texas Instruments
James Cannon - Motorola
Norm Colbath - Austin Community College
Mark Kincaid - Leander High School
Joe Keener - Leander High School
Jim O'Connor - Lockheed
Maggie Rice - Leander I.S.D.
John Rundell - IBM
Ron Smith - 3M
Judy Van Cleve - Austin Community College
Adriana Barrera - Austin Community College
Jeanne Yturri - Tracor
Lewis Igo - Austin I.S.D.

An update on Principles of Technology was given by Mark Kincaid, Leander High School PT instructor. He stated that Principles of Technology I was on the same time-line as last year's class. Principles of Technology II was moving at a slower pace because of the different level of difficulty. Scores are progressing and interest has been high. A parent orientation for the Principles of Technology and 2 + 2 program was held and there

should be three full classes signed for PT I for next year.

Charles Rouse, Leander High School principal, felt that from one-hundred fifty (150) to two-hundred (200) students would be exposed to this program next year. Allen Boger, 3M, asked how many instructors would be used. There still will be just two instructors. James Cogdell asked if the Principles of Technology classes were addressing the "At Risk" students and Mr. Rouse assured him that they were being addressed.

Bert Marcom, A.C.C., added that from Austin Community College's viewpoint the parent orientation received a good response. The Principles of Technology class held at night for A.C.C. was progressing quickly. Mark Kincaid stated that there were nineteen (10) to twenty (20) students in the class and he has found that the communication is better in working with adults. Allen Boger, 3M, asked if most of the students are from manufacturing. Bert Marcom stated that most of the people from the group were recruited by the Advisory Committee.

Larry Miller, A.C.C., presented a wonderful video presentation on the Principles of Technology and 2 + 2 Program. This video was a part of the grant funding for this year. It was well received by all members of the committee.

James Cogdell, T.E.A., said he would like to see a follow-up done on continuing education and what has happened to the students presently enrolled in the PT Program. "It would be nice to see a student who has been through the program involved in a job situation."

George Matott, Texas Instruments, stated that the Texas Council on Vocational Education was taking recommendations to substitute Principles of Technology for some science credit in the State curriculum.

The next meeting of the Advisory Committee will be June 21 at 9:00 A.M. at the Leander High School library.

The meeting was then adjourned at 11:00 A.M.

MINUTES

ADVISORY COMMITTEE MEETING
PRINCIPLES OF TECHNOLOGY PROJECT

JUNE 21, 1988
11:30 A.M.

The final meeting of the Advisory Committee was called to order at 11:30 A.M. on June 21, 1988, at Lone Star Cafe on Highway 183. Those in attendance were:

Linda Hanson Gray - Leander I.S.D.
Charles Rouse - Leander High School
Hubert Dixon - Leander High School
Joe Keener - Leander High School
Mark Kincaid - Leander High School
Alan Sosbe - C.O.R.D.
Adriana Barrera - Austin Community College
Chuck Bradley - Texas Instruments
James Cannon - Motorola
Robert Mann - Radian Corporation
George Matott - Texas Instruments
John Rundell - IBM
Walter Stone - KMW Systems Corporation
James Cogdell - Texas Education Agency
Norm Colbath - Austin Community College
Maggie Rice - Leander I.S.D.

Hubert Dixon, Leander High School counselor, gave an update on the class projections for next year in Principles of Technology. PT I will have seventy-one (71) students and PT II will have sixteen (16) students. Mark Kincaid will continue to teach both of the PT classes.

Charles Rouse and Linda Gray thanked all of the committee members for their attendance, input and valuable assistance in this Principles of Technology Project for the past two years. After these expressions of gratitude, James Cogdell of the Texas Education Agency also thanked the group for their hard work in this effort.

The group then ate and visited and the meeting was adjourned about 1:00 P.M.